and r_u is expressed in meters. For large keepout ranges, a 4/3 earth radius assumption is employed to derive a conservative off-pointing angle to the airborne MLS user. Space loss and antenna gain can be calculated in a straightforward manner from r_u and θ.

Section 3
Link Budget Analysis for Out-of-Band Emissions

This section addresses MES gateway emissions in the 5000 - 5250 MHz band exclusive of the 5031 - 5091 MHz band occupied by MLS.

One key issue for the out-of-band RFI analysis is determination of an equivalent noise bandwidth for the MSS uplink signal received by the airborne MLS equipment. The ARINC Characteristic which defines tolerable out-of-band RFI signal levels (i.e., in the 5000-5250 MHz band exclusive of the 5031-5091 MHz band occupied by MLS), references a CW signal rather than the broadband modulated signal of the MSS gateway uplink. As a baseline, the following analysis takes the conservative approach of integrating the uplink transmitter power over the entire 190 MHz of relevent bandwidth, and considers this to be a single interfering signal. In this bandwidth, consisting of 30 MHz below the MLS band and 160 MHz above it, there will be six (6) active subbands of 16.5 MHz each, the remaining spectrum is devoted to guardbands. Each active subband employs dual polarization reuse with a maximum power spectral density of -16 dBW/4kHz/polarization. While spacecraft power limitations and operational restrictions would prevent all subbands from being keyed at this power level simultaneously, this analysis adopts the worst-case assumption that all subbands are, indeed, keyed at this level.

Exhibit 2 presents a link budget analysis at r_u = 30 nmi. Note that the transmitter signal power is integrated over the full 190 MHz of bandwidth, as discussed above, picking up all power contributions from all active subbands outside the MLS allocation. At a range of 30 nmi, the worst-case equivalent gateway antenna gain toward an airborne MLS user is 17.25 dBi and the space loss is 141.3 dB. Total system margin is about 20 dB in this case, relative to the specified tolerable RFI power level of -85 dBW (-55 dBm) for CW signals.

Exhibit 3 explores the potential to reduce keepout range r_u. When keepout range is reduced to 20 nmi with all other parameters held constant, margin is negative. To restore positive margin, the gateway facility design would have to incorporate physical screens, limits on antenna pointing angles, or terrain blockage in the environment.

Section 4
Summary of Out-of-Band Link Budget Analysis

At a user keepout range of 30 nmi, equivalent to an MLS ground site keepout range of 50 nmi, roughly 20 dB of margin exists relative to the most conservative analytic assumptions. Smaller keepout ranges are potentially feasible, but require special considerations in the gateway facility design or the local environment. We will see in the following section that inband RFI actually represents the dominant constraint for MSS gateway site selection; as a result, a 50 nmi keepout range from the MLS site represents a reasonable lower bound on the protection zone.

Globalstar Gateway/MLS Interference Assessment
(Out-of-band assessment)

Scenario parameters:

Range to MLS user 30 nmi

Elevation angle (4/3 earth) = 6.1101 degrees

Link budget parameter	Value	Units	Notes
Transmitter Power Density	-16.00	dBW/4kHz	
Integrate over 190 MHz	46.95	dB(4kHz)	6 subbands @ 16.5 MHz ea.; dual pol.
Antenna gain toward MLS user	17.25	dBi	Antenna sidelobe at 32-25 log θ
Transmit EIRP in RFI	48.20	dBW	
Space loss	-141.32	dB	Range = 55590 meters = 30 nmi
Shielding/Shadowing	0.00	dB	
Polarization isolation	-1.00	dB	Estimate: circular to linear
MLS user ant. gain @ RFI	0.00	dBi	
Received Carrier Power (MSS)	-94.12	dBW	
Line loses	-11.00	dB	ARINC characteristic 727-1
RFI level at MLS RCVR processor	-105.12	dBW	
RFI specifications (MLS)	-85.00	dBW	Equivalent to ARINC spec of -55 dBm
Margin	20.12	dB	

GI.Q-102

Exhibit 2: Link budget analysis of out-of-band RFI at r_u = 30 nmi

Globalstar Gateway/MLS Interference Assessment
(Out-of-band assessment)

Scenario parameters:

Range to MLS user 20 nmi
Elevation angle (4/3 earth) = 9.3452 degrees

Link budget parameter	Value	Units	Notes
Transmitter Power Density	-16.00	dBW/4kHz	
Integrate over 190 MHz	46.95	dB(4kHz)	6 subbands @ 16.5 MHz ea.; dual pol.
Antenna gain toward MLS user	36.60	dBi	Antenna sidelobe at 32-25 log θ
Transmit EIRP in RFI	67.55	dBW	
Space loss	-137.80	dB	Range = 37060 meters = 20 nmi
Shielding/Shadowing	0.00	dB	
Polarization isolation	-1.00	dB	Estimate: circular to linear
MLS user ant. gain @ RFI	0.00	dBi	
Received Carrier Power (MSS)	-71.25	dBW	
Line loses	-11.00	dB	ARINC characteristic 727-1
RFI level at MLS RCVR processor	-82.25	dBW	
RFI specifications (MLS)	-85.00	dBW	Equivalent to ARINC spec of -55 dBm
Margin	-2.75	dB	

GLQ-106

Exhibit 3: Link budget analysis of out-of-band RFI at r_u = 20 nmi

Section 5
Link Budget Analysis for In-Band Emissions

Exhibit 4 illustrates a link budget analysis for in-band emissions at a range of 30 nmi from the MLS user. This link budget is similar to the out-of-band budgets presented earlier, save for the following differences:

a) transmit power is integrated over only 150 kHz, corresponding to the channel bandwidth assumed for RFI calculations in ICAO Annex 10.

b) the RFI specification is taken as -122 dBm, corresponding to the noise power over a 150 kHz equivalent channel bandwidth referenced in ICAO Annex 10.

As can be seen, link margin is approximately -19 dB. If line losses are reduced to -5 dB as assumed by ICAO, rather than the -11 dB assumed in ARINC Characteristic 727-1, link margin would be closer to -25 dB.

Exhibit 5 illustrates a link budget analysis for in-band emissions at a range of 174 nmi; essentially the range at which the MLS user would appear at the horizon assuming a 4/3 earth. At this range, link margin is approximately -7 for line losses taken at -11 dB, and would be approximately 1 dB for line losses taken at -5 dB.

Section 6
Summary of In-Band Link Budget Analysis

The conclusion to be drawn from the link budgets of Exhibits 4 and 5 is that, for MLS users within line of sight, and at the same azimuth as the MSS gateway antenna boresight, MSS gateway emissions at a power density of -16 dBW/4kHz are marginally acceptable at the radio horizon, and unacceptable inside the horizon.

Section 7
MSS/MLS Frequency Coordination Strategies

Given the limited number of MLS deployments planned by the FAA (and the probable equivalent situation in Europe and elsewhere overseas), it would certainly be possible to coordinate MSS and MLS operations by imposing keepout zones around each MLS site equivalent to the radio horizon. On the other hand, special features at an MSS gateway (preexisting or explicitely engineered), as well as active coordination strategies, may allow coexistance inside the radio horizon. Relative to the link budget of Exhibit 4, taken at 30 nmi, we see that an additional 25-30 dB of isolation is required. This may be achieved by a combination of increased separation, terrain masking, RF fences and physical stops on the MSS gateway antenna that would prevent low elevation angle transmissions. For example, increasing the user keepout range to 80 nmi yields 8.5 dB; an RF fence would conservatively yield 10 dB, and an antenna stop at 15 degrees elevation (in the direction of the MLS service volume) would yield a reduction in worst-case directive antenna gain of 13 dB relative to the value cited in Exhibit 4 (note: this is a combination of improvements due to the relatively lower elevation angle of the worst-case MLS user, as well as the increase in minimum elevation angle of the MSS gateway antenna). The sum of these improvements is 31.5 dB, implying satisfactory performance despite nominal line-of-sight operations (margin would be 13 dB). In selected cases, existing terrain masking may add additional isolation, or allow some

Globalstar Gateway/MLS Interference Assessment
(In-band assessment)

Scenario parameters:

Range to MLS user 30 nmi
Elevation angle (4/3 earth) = 6.1101 degrees

Link budget parameter

	Value	Units	Notes
Transmitter Power Density	-16.00	dBW/4kHz	
	18.74	dB(4kHz)	Peak power over 150 kHz; dual pol.
Antenna gain toward MLS user	17.25	dBi	Antenna sidelobe at 32-25 log θ
Transmit EIRP in RFI	19.99	dBW	
Space loss	-141.32	dB	Range = 55590 meters = 30 nmi
Shielding/Shadowing	0.00	dB	
Polarization isolation	-1.00	dB	Estimate: circular to linear
MLS user ant. gain @ RFI	0.00	dBi	
Received Carrier Power (MSS)	-122.33	dBW	
Line loses	-11.00	dB	ARINC characteristic 727-1
RFI level at MLS RCVR processor	-133.33	dBW	
RFI specifications (MLS)	-152.00	dBW	Equivalent to ICAO spec of -122 dBm
Margin	-18.67	dB	

GLQ-106

Exhibit 4: Link budget analysis of in-band RFI at r_u = 30 nmi

Globalstar Gateway/MLS Interference Assessment
(In-band assessment)

Scenario parameters:

Range to MLS user 173.7 nmi
Elevation angle (4/3 earth) = 0.0017 degrees

Link budget parameter

	Value	Units	Notes
Transmitter Power Density	-16.00	dBW/4kHz	
	18.74	dB(4kHz)	Peak power over 150 kHz; dual pol.
Antenna gain toward MLS user	7.00	dBi	Antenna sidelobe at 32-25 log θ
Transmit EIRP in RFI	9.74	dBW	
Space loss	-156.57	dB	Range = 321866 meters = 173.7 nmi
Shielding/Shadowing	0.00	dB	
Polarization isolation	-1.00	dB	Estimate: circular to linear
MLS user ant. gain @ RFI	0.00	dBi	
Received Carrier Power (MSS)	-147.83	dBW	
Line loses	-11.00	dB	ARINC characteristic 727-1
RFI level at MLS RCVR processor	-158.83	dBW	
RFI specifications (MLS)	-152.00	dBW	Equivalent to ICAO spec of -122 dBm
Margin	6.83	dB	

GLQ-106

Exhibit 5: Link budget analysis of in-band RFI at r_u = 174 nmi

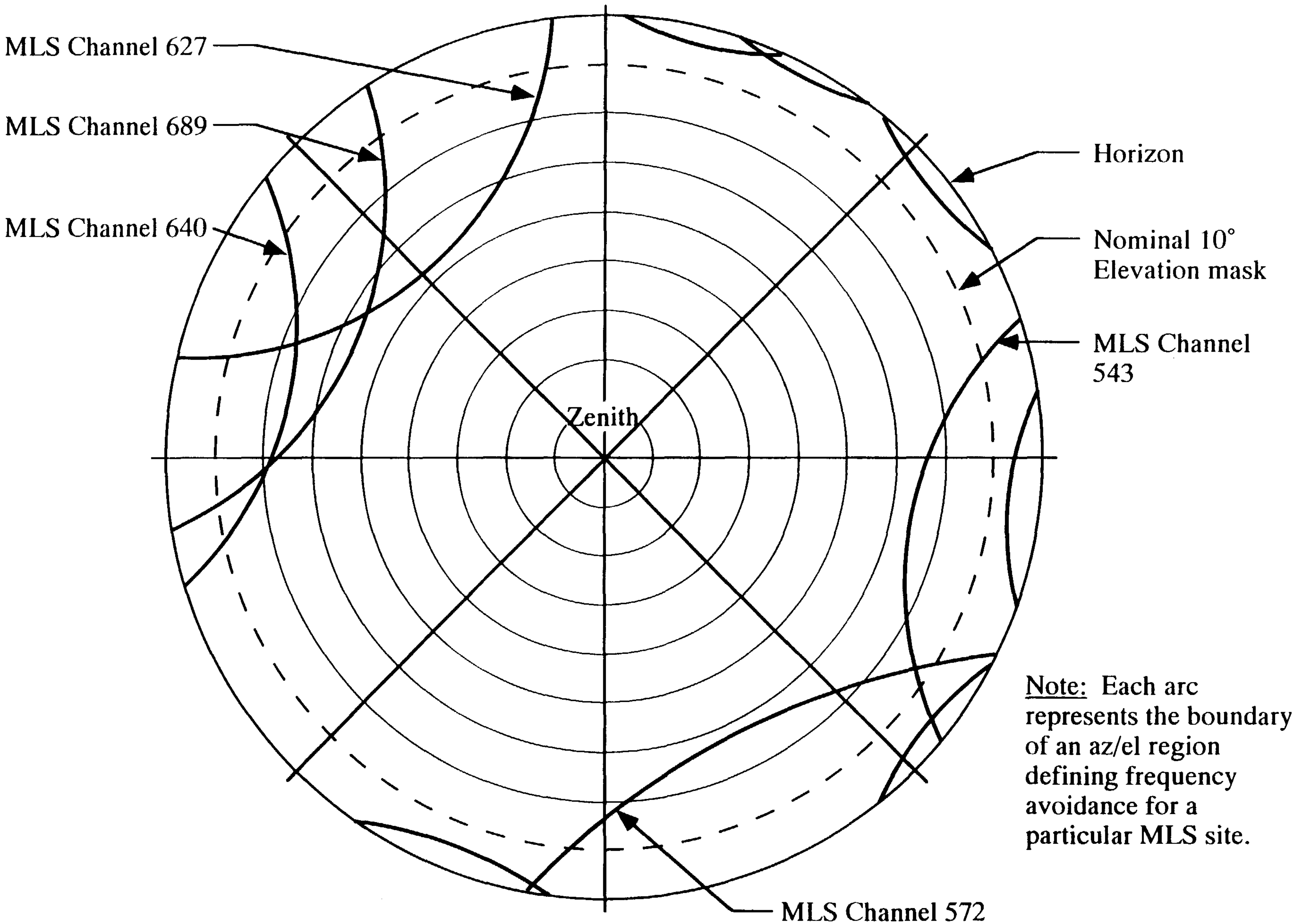


Exhibit 6: Conceptual Az/El Mask for MLS Channel Avoidance

GLQ-115

tradeoff of keepout distance, fence design or antenna stops.

Finally, it may be possible to reduce power density by 25-30 dB on selected MSS channels, through active techniques, in order to protect MLS operations at shorter ranges than illustrated above. One way to do this would be to define an az/el mask for each MSS gateway station, such that specified MSS channels are avoided (i.e., forced to zero activity) as the antenna boresight moves within a specified angular offset of MLS service volumes operating on known frequencies. While the excluded band could be as narrow as 150 kHz based on MLS requirements, the waveform design of the Globalstar system implies that the vacated bandwidth would actually be 1.2 MHz or multiples thereof. This would offer substantial guardbands and engineering margin. A conceptual illustration of such an az/el mask is presented in Exhibit 6. The illustration is a polar plot referenced to the MSS gateway, with the center of the plot indicating the zenith and the remainder associated with specific azimuth/elevation coordinates. The horizon is the outermost circle. The arcs are associated with MLS service volumes and MLS channel assignments. Each arc represents a boundary of a region requiring avoidance of a specific MLS channel number (and therefore a specific *MSS* channel number) by the MSS gateway.

For the MSS system, an active coordination strategy would imply a theoretical reduction in channel availability when the MSS gateway station antenna boresight is close to the horizon. However, the negative impact can be mitigated by designing the spacecraft such that the MLS band is used to support the so-called "outer beams" of the L-band antenna used for MES downlink transmissions. These beams are projected to carry less traffic than the inner beams; thus, a theoretical reduction in channel availability will have minimal impact on user perceived quality of service and overall system revenues.

It should be noted that the az/el mask would be built to consider all MLS service volumes within 200-250 nmi of the MSS gateway, thereby ensuring that all MLS users within line-of-sight (assuming a 4/3 earth) are protected. Assuming that power densities can be reduced by 30 dB on unkeyed channels, an active avoidance strategy could potentially allow MSS gateway operations as close as 30 nmi from MLS users (50 nmi from MLS ground sites). The disadvantage of this strategy is its reliance on software algorithms to ensure frequency avoidance as a function of antenna boresight azimuth and elevation. Given the potential impact on flight safety, this software would almost certainly require technically challenging (and costly) development and certification techniques.

Section 8
Overall Summary of Link Budget Analysis

The out-of-band link analysis indicates that a reasonable lower bound on MSS/MLS keepout distance is about 30 nmi referenced to the worst-case MLS user, or 50 nmi referenced to the MLS ground site. However, in-band emissions require coordination whenever an MLS service volume is within line-of-sight. A reasonable coordination strategy is to set a nominal keepout distance of 100 nmi around each MLS ground site, and thereafter define site-specific mitigation techniques, such as RF fences and physical antenna stops, in conjunction with the terrain masking characteristics specific to that site. Active frequency avoidance via software algorithms embedded in the channel assigment routines are also feasible, but may only be cost-effective in areas where MLS sites are numerous. This may occur in Europe or elsewhere overseas, but is not expected to occur in the United States. Exhibit 7 illustrates a map of the continental United States with the 19 currently planned MLS sites identified along with their associated 100 nmi keepout zones. It should be noted that the precise deployment will depend on the outcome of ongoing analysis and decision-making by the FAA. Regardless of the outcome of this process, the remaining land area would appear to offer sufficient flexibility for MSS gateway siting. Appendix B discusses in some detail the process by which the locations of the MLS airport sites were determined. A range of protection zones around the airports from 30-200 nautical miles is shown.

Exhibit 7

19 Airport projected MLS sites in U.S. (lower 48) showing a 100 nautical mile radius interference protection region

Appendix A

Relevent Background Data Regarding MLS

The Microwave Landing System (MLS) is a time-referenced scanning-beam (TRSB) navigation system which scans fan-shaped beams in elevation and azimuth in a to-and-fro motion. The airborne equipment measures the asymetric timing of the to-and-fro beams to determine its own relative azimuth and elevation angle from the ground station. Digital data is also transmitted to provide information on the supported landing site, and system operations. According to original Aeronautical Radio, Inc. (ARINC), RTCA and International Civil Aviation Organization (ICAO) documentation, MLS operates on one of 200 channel assignments in the 5031 to 5091 MHz band. Range is determined by an associated system (DME/P) operating at a lower frequency.

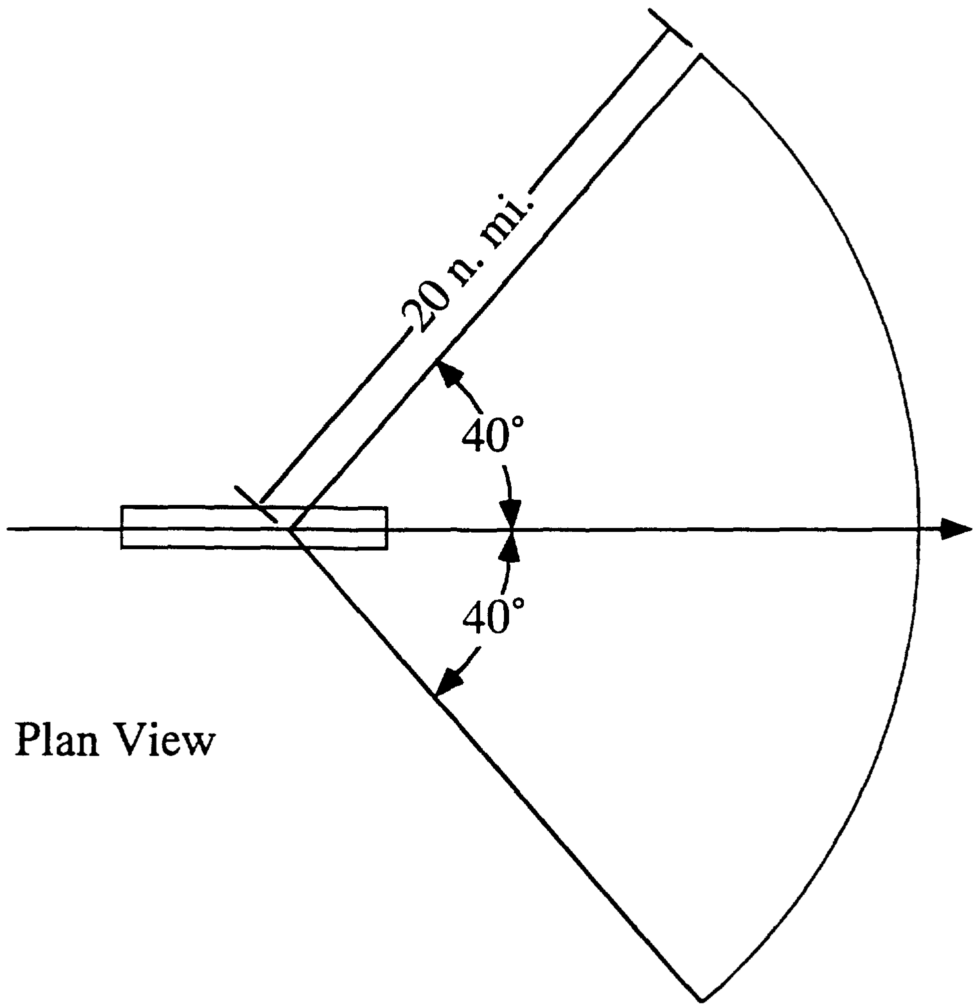
In 1989, the ICAO All Weather Operations Panel (AWOP) extended the upper edge of the MLS frequency band to 5150 MHz in order to accomodate additional channel assignments. This was intended to avoid potential channel congestion and frequency coordination problems among MLS sites that was anticipated for the European theater (and to a lesser extent the United States) at that time. However, since 1990, the world-wide aviation community has shifted focus to embrace satellite navigation technology (specifically, the Global Positioning System (GPS), the Global Orbiting Navigation Satellite System (GLONASS), and differential/augmented systems based on these systems). In the United States, the FAA has recently cancelled both the MLS program and the DME/P program. The existing inventory of 30 MLS systems will be deployed at 30 airports or less.

In Europe, the status of MLS is not clear. The technical consensus is that satellite-based navigation systems can provide the needed precision approach and landing capability at lower cost, and with greater flexibility, than MLS. MLS may retain a limited role as an alternate or backup system for Category I precision approach, or as a near-term solution to the Category II/III precision approach domain. In either case, the number of deployed sites is expected to be limited. As a result, this analysis assumes that the original MLS frequency band (5031 - 5091 MHz) will be adequate for all future deployments. This allows existing RTCA and ARINC documentation, which was never updated following the ICAO AWOP action in 1989, to support any residual MLS equipment development that may occur.

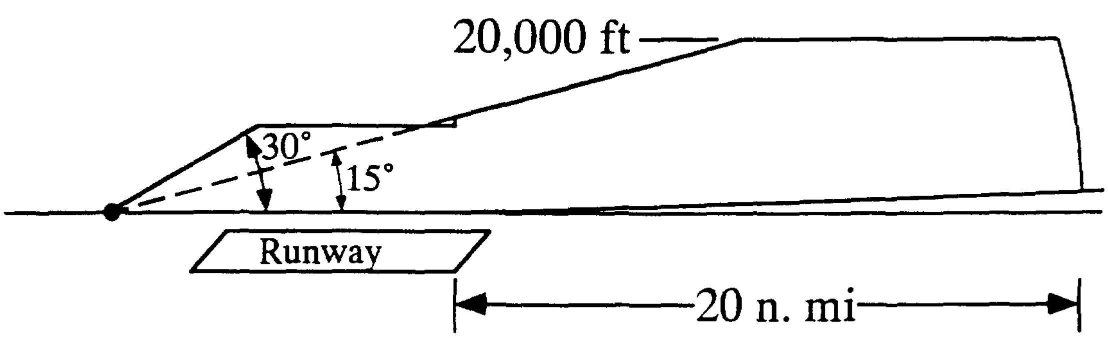
The operating range of MLS is 20 nmi from the supporting ground equipment. Typically, service will be provided in a sector $\pm$ 40 degrees in azimuth and 30 degrees in elevation. However, the system can be configured with coverage over the full 360 degrees in azimuth (it should be noted that operation at maximum range and maximum elevation is highly unlikely). The coverage "ceiling" of the MLS is 20,000 feet above ground level (AGL). Exhibits A-1 and A-2 illustrate the coverage volume for the azimuth and elevation scanning beams for a typical MLS installation. In Europe, the ICAO AWOP action in 1989 also reduced the vertical ceiling to 10,000 feet in order to minimize frequency coordination complexity. This report will consider only the 20,000 foot ceiling as the worst-case for both the United States and Europe.

The minimum specified signal level at 20 nmi is -95 dBm at the output port of a nominal 0 dBi antenna.[1] However, the ***nominal*** signal level is actually -70 dBm.[2] Some performance

1. **Airborne Microwave Landing System,** ***ARINC Characteristic 727-1***, para. 3.1.3 (commentary), August 27, 1987.
2. **Minimum Operational Performance Standards for Microwave Landing System (MLS) Airborne Receiving Equipment,** ***RTCA/DO-177***, July 17, 1981.



Plan View



Elevation View

Exhibit A-1: Azimuth Scanning Beam Coverage Volume

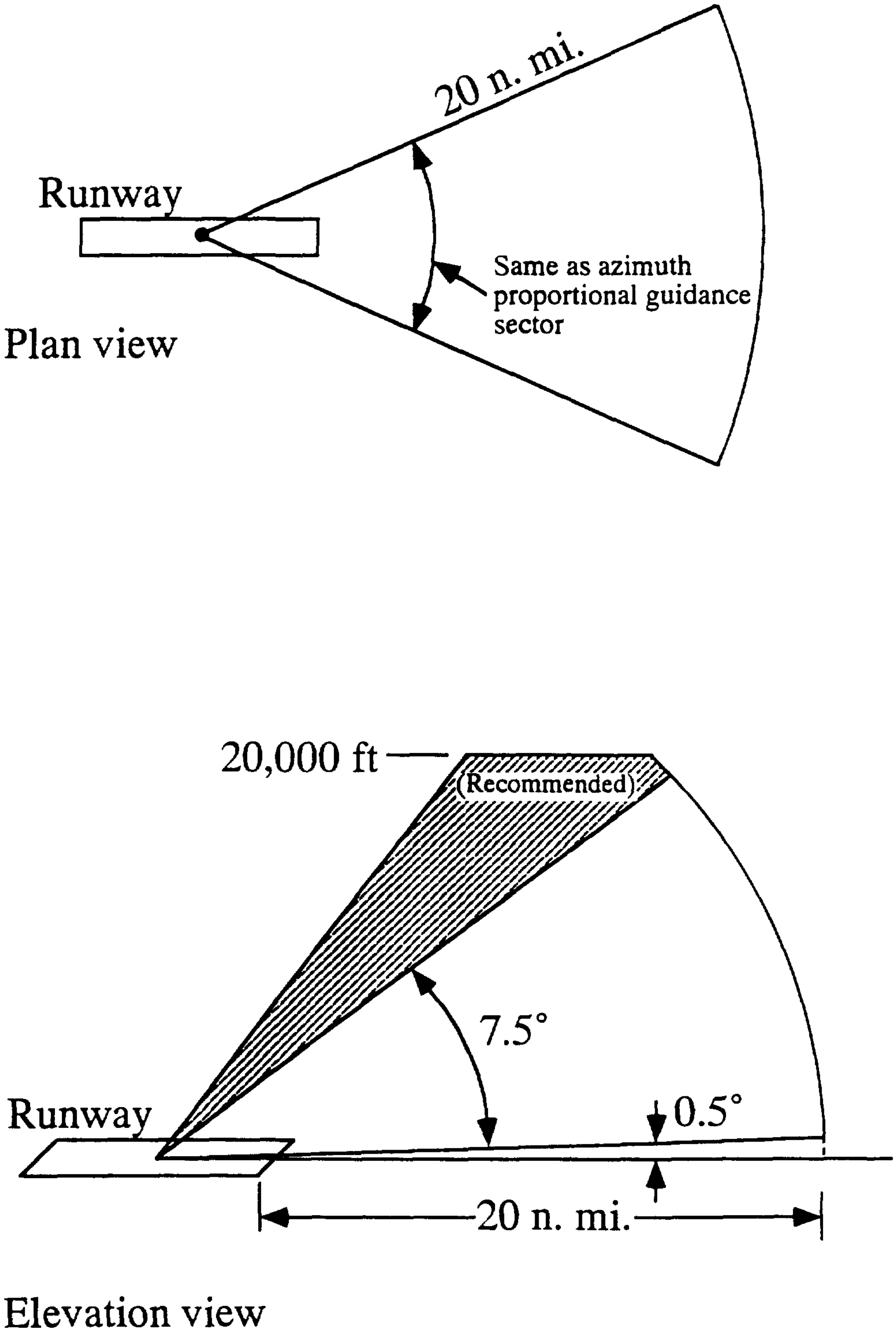


Exhibit A-2: Elevation Scanning Beam Coverage Region degradation is allowed for signal levels between -70 dBm and -95 dBm (degrading linearly up to 2 times the error values specified in RTCA/DO-177, table 2-1).

The fan beams have beamwidths in their narrow dimension of between 0.5 and 4 degrees. The scan rate of the fan beams has been standardized by ICAO at 0.02 degrees per microsecond. The bandwidth of the filter process that detects the scanning beams (and supports centermarking) shall be no greater than 26 kHz in order to accommodate electronically-scanned beams.[3]

Basic auxiliary data is transmitted using DPSK modulation with symbol durations of 64 microseconds. The null-to-null data bandwidth is thus approximately 32 kHz.

Based on the mandated bandwidth of the filter used for centermarking the scanning beam, and the data rate of the superimposed DPSK data link, one might conclude that the equivalent channel bandwidth of an MLS receiver is conservatively upper-bounded by 50 kHz. However, ICAO Annex 10 references a bandwidth of 150 kHz in all link power budgets. The wider bandwidth provides for relatively sharp transition in the data demodulation process. This report assumes the receiver bandwidth is 150 kHz; note that this may imply "hidden margin" of as much as 7 dB relative to the navigation subfunction.

MLS receiving equipment must contend with signal power fluctuation due to rotor modulation, as well as multipath from aircraft structures and the terrain. Specifications for multipath tolerance are framed relative to a desired signal strength between -20 dBm and -87 dBm. Note that the specification for performance in a multipath environment references a signal level that is 8 dB above the minimum signal strength specified in ARINC 727-1. For desired signal strength in the specified range, and multipath signals between 3 and 5 dB below the desired signal, the induced angular errors should be between 0.5 and 0.3 beamwidths, respectively.

The MLS receiver processor is required to operate in an environment that contains radio frequency interference (RFI). The specifications for tolerable RFI depend on the signal type (i.e., whether the signal is CW broadband noise, pulsed interference or another MLS signal), and whether the interference is in the specific MLS subband (5031-5091 MHz) or outside it. ARINC Characteristic 727-1 frames these specifications for the cases of CW out-of-band interference and MLS-like signals generating in-band interference. Exhibit A-3 illustrates the specified maximum RFI levels under which the MLS receiver processor must continue to function. These power levels are referenced to the input of the MLS receiver processor.

Within the MLS band (5031-5091 MHz), the interference is assumed to originate from another MLS transmitter and the tolerable level of RFI depends on the frequency offset from the selected MLS channel . For interfering signals within 1.2 MHz of the selected channel, the maximum tolerated signal level is -64 dBm. For interfering signals greater than 1.2 MHz from the selected channel, the maximum tolerated signal level is -40 dBm.

In the 5000-5250 MHz band, excluding the MLS band, the maximum tolerated RFI signal level is -55 dBm. This is for CW signals. No guidance is offered in the specifications regarding equivalent noise bandwidth for modulated signals or broadband noise.

The tolerance vis-a-vis ***in-band*** interference, as would be generated by the spread-spectrum MSS uplink, is not specified by ARINC or RTCA documentation. However, ICAO Annex 10 contains a power budget for airborne equipment that references a noise floor at the MLS receiver of -122 dBm. The equivalent noise bandwidth used for this calculation is 150 kHz.

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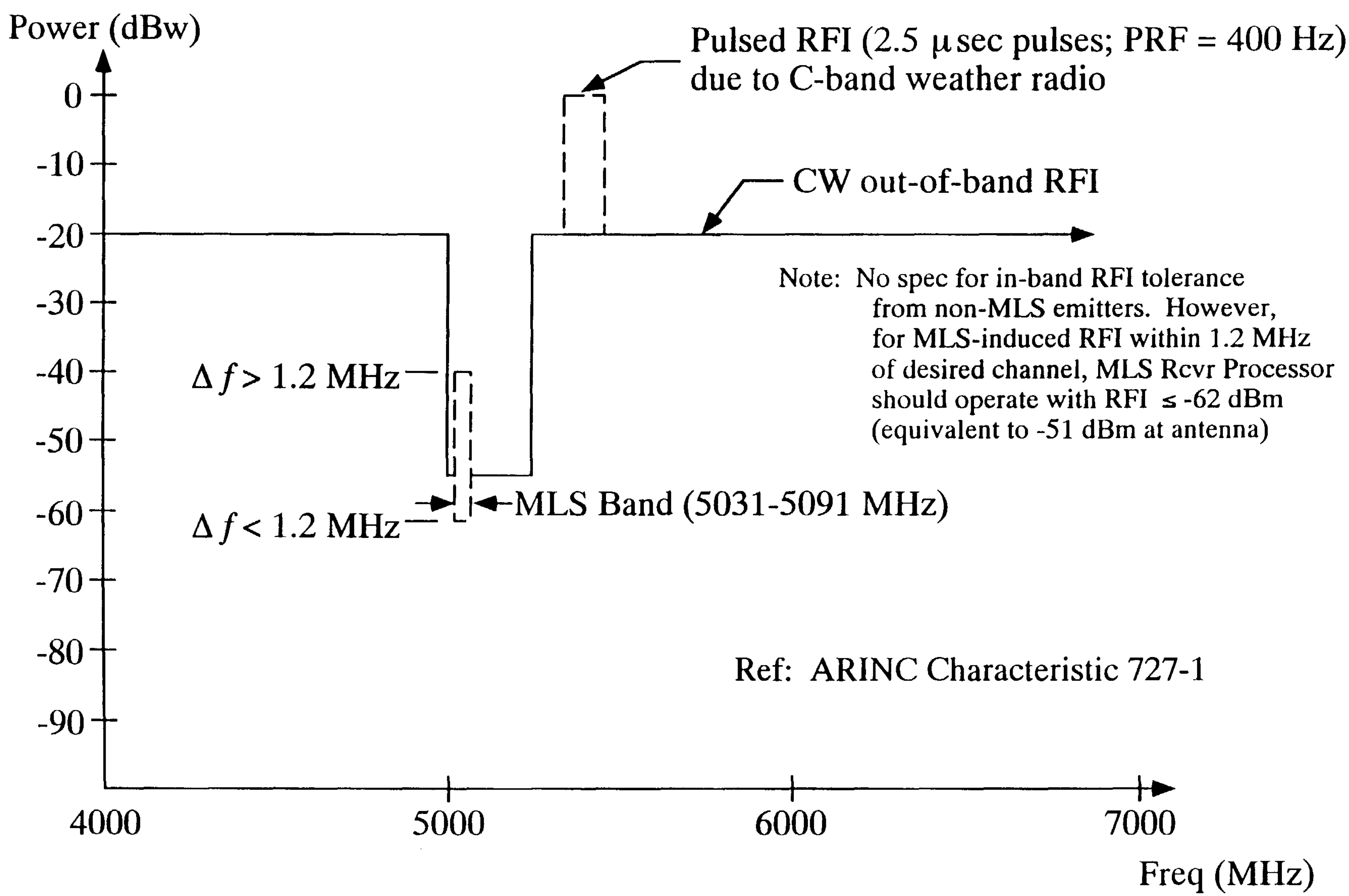
3. Ibid., paragraph 2.1.10.2.

Exhibit A-3: MLS Receiver Processor Tolerance to RFI



Appendix B

An Interference Analysis of Globalstar Feeder Link Operation for the Protection of MLS Equipped Airport Locations in the U.S.

For the Globalstar system to provide its services to North America, about ten to twelve feeder link stations are to be distributed throughout the United States. These stations provide connectivity with the Globalstar constellation of satellites and are planned for uplink operation in the C-band region of the spectrum, specifically in the 5000-5250 MHz frequency range. Since this band is also used, from 5031 to 5091 MHz, for the FAA's microwave landing system (MLS), it needs to be demonstrated that operation of the Globalstar feeder links will not interfere with the MLS frequencies used at the MLS equipped airports. This has been analyzed and straightforward solutions have been found.

In establishing the planned MLS site locations for the interference analysis, it was necessary to obtain information from the FAA on the current status and plans for MLS implementation. Those contacted in the FAA provided a substantial amount of relevant information and documentation. However, major decisions on the MLS program and its relationship to satellite-based system (DGPS) capabilities for precision approach and landing are being discussed at the highest levels in the FAA and on an international basis. On June 2, 1994 the implementation plans were dramatically clarified by FAA Administrator David R. Hinson when he announced that "continuing the MLS development program is not an economically sound strategy, since all indications are that we will never need to deploy Category II and III systems in any significant numbers." The FAA indicated that it will be limiting its deployment of MLS to the 7 airports where it already has Category I MLSs and to 22 other airports where it is in the process of installing additional Cat I MLSs. The Administrator said he believes satellite based technology using the Global Positioning System (GPS) will have greater potential to do a better job.

Definitive information on MLS implementation plans (e.g. locations, numbers of sensors, frequencies and power levels) that provide the data necessary for the analysis of feeder link interference effects is necessary to develop a credible scenario for a realistic evaluation. FAA data currently available, therefore needs to be assessed and reasonable projections made as to the number and locations of MLS sensors to be considered. The following steps describe the rationale used to develop a conservative current scenario for planned MLS site locations. The interference analysis, based on this data, is then accomplished. The data employed and the methodology for developing the implementation scenario and the location-sensitive interference analysis are as follows:

1. Facility site data originally established in the late 1980's for MLS sites is included in the U.S. DOT Federal Aviation Administration **NAS System Specification, Volume I, Functional and Performance Requirements for the National Airspace System, General - Appendix II, NAS Architecture**, (NAS-SS-1000) dated February 1993. The site data is included as Table 20.6.2-7 on pages II-103 through II-118. This list is entitled **Facility Site Data, Airport Facilities, Subsystem MLS** and includes 662 airport sites with their location identifiers (LIDs), names and location, their latitude and longitude coordinates and the number of new facilities planned for these locations. This list includes many more sites than the FAA currently plans to deploy and it has been superceded by more recent FAA plans, including both the **FAA Aviation System Capital Investment Plan (CIP)** dated December, 1993 and the most recent announcement by the FAA Administrator. NAS-SS-1000, however, is the only

number of new facilities planned for these locations. This list includes many more sites than the FAA currently plans to deploy and it has been superceded by more recent FAA plans, including both the **FAA Aviation System Capital Investment Plan (CIP)** dated December, 1993 and the most recent announcement by the FAA Administrator. NAS-SS-1000, however, is the only available document which provides information on all candidate MLS locations. Information on this document was obtained from Mr. Tom Laginja of the FAA.

2. The Microwave Landing System Program Office manager and deputy were contacted (Mr. Gary Skillicorn, Manager and Mr. Steve Wolf, Deputy) for information on the locations for the planned MLS installations. Mr. Skillicorn directed the request to Mr. Wolf who stated that no prepared listing was available for the FAA Capital Investment Plan MLS locations. However, he agreed to provide data from other sources for the site locations. A 17 page table was received from Mr. Wolf for the locations of the **International Runway End Designations**, which listed pertinent data on these (formerly) planned MLS installations. A listing of the MLS installations planned for "non-international" runways was also received. The data received provides information on 236 MLS installations located at 101 international airports in the United States and its possessions. This includes data relating to the locations of the final 29-30 MLS sites which are currently installed or planned for deployment.

3. Information received from Mr. Rial Sloane, FAA Manager of Advanced systems for Landing, indicated that 28 Category I MLS sensors are in the process of installation or installed. These MLS site locations are given in Exhibit 8-1. The assumption is made for this analysis that MLS will be deployed for Cat I applications at 7 existing and 22 planned airports, as indicated in FAA Administrator Hinson's June 2nd announcement (attachment 1). Information from various sources in the FAA, including the Administrator's announcement, indicates that precision approach and landing systems based on satellite system technology (DGPS) will be deployed for essentially all Cat I applications. These GPS systems show the potential for satisfying higher categories of approach and landing as well, and may be used for this depending on the results of test and demonstration programs that the FAA is initiating.

4. The effect of interference on the MLS sites from the Globalstar feeder link operation in the 5000-5250 MHz band is then considered. This is done by establishing the required minimum separation distances associated with the feeder link stations relative to the MLS sites. The determination of the separation distance is established in Section 7.

5. These potential interference regions are plotted on maps of the United States (lower 48) and Alaska. The minimum separations are plotted as circles with their radii equal to an established interference protection distance. Each circle is centered on one of the 30 airport (MLS) locations. These are illustrated as US48 and Alaska plots in Exhibits 8-2 through 8-6 (a and b), respectively. To provide a perspective on the coverage regions associated with a range of interference protection distances, plots are shown for 30, 50, 100, 150, and 200 n.miles. The area not covered by the interference protection circles is that region which provides acceptable Globalstar feeder link operation.

A tabulation of the MLS installations and airport locations is given in Exhibit B-7. Although the FAA announcement indicates that 7 MLS sites are operational, the FAA has provided data on only three. The other 4 sites are probably included in the listing of 27 planned sites (and 1 TBD site). Of the 30 existing and planned MLS equipped locations analyzed, 19 are in the lower 48 states and 11 are in Alaska.

It is apparent from the plots of Exhibits 8-2 through 8-6 that a very substantial amount of geography in the lower 48 and in Alaska is available for feeder link location, even considering a 200 n.mi. radius protection region around each MLS airport location.

Exhibit 8-1

MLS Installations and Airport Locations

Estimates Based upon Data Provided by FAA

	Total MLSs	Total Sites
I. Cat I operational MLSs from FAA Advanced Systems for Landing (Attachment E):	3	3
II. Cat I MLS installations funded and built; in process of installation; also from FAA Advanced Systems for Landing (Attachment E):	28	28
III. Less sites "to be designated":	-1	-1
IV. Totals of above MLS procurements:	30	30

Exhibit 8-2a

19 Airport projected MLS sites in U.S. (lower 48) showing a 30 nautical mile radius interference protection region

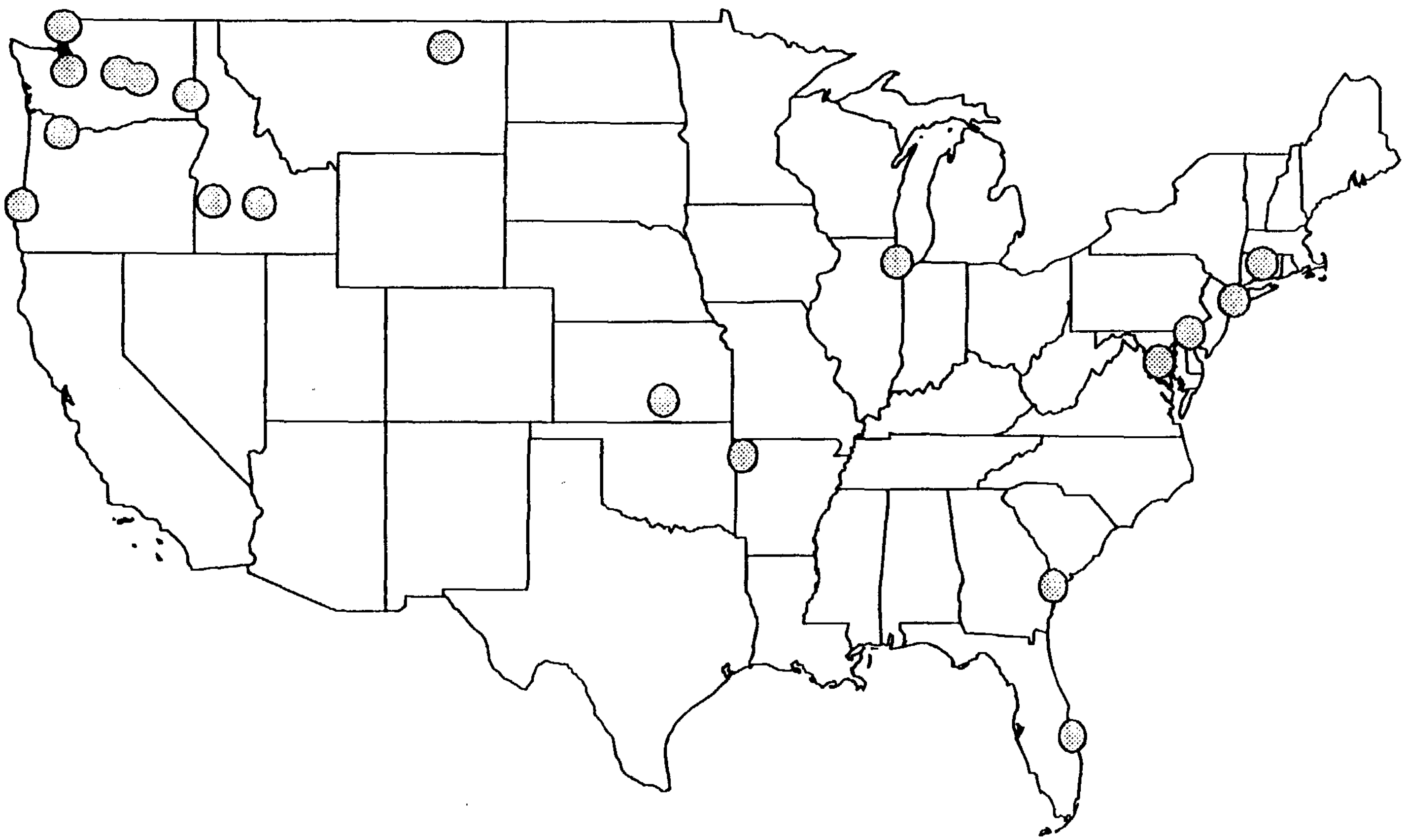


Exhibit 8-2b

11 Airport projected MLS sites in Alaska showing a 30 nautical mile radius interference region

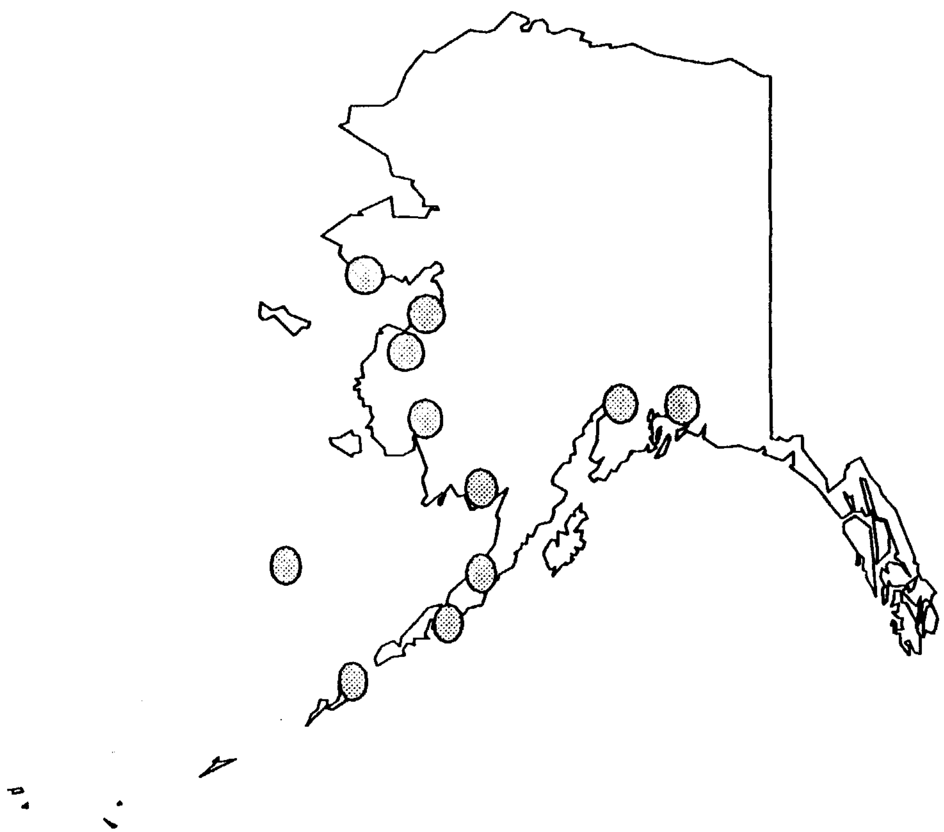


Exhibit 8-3a

19 Airport projected MLS sites in U.S. (lower 48) showing a 50 nautical mile radius interference protection region

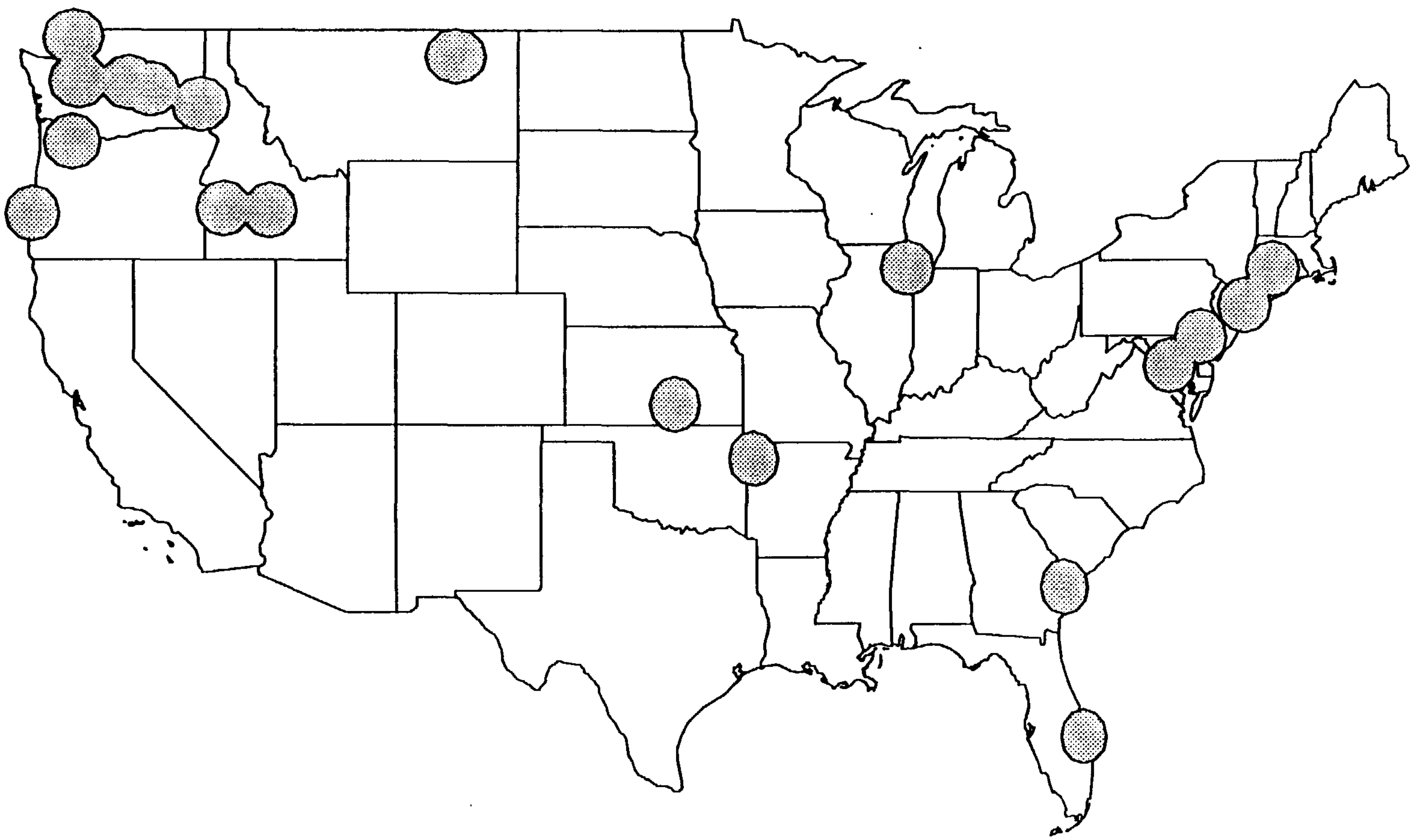


Exhibit 8-3b

11 Airport projected MLS sites in Alaska showing a 50 nautical mile radius interference protection region

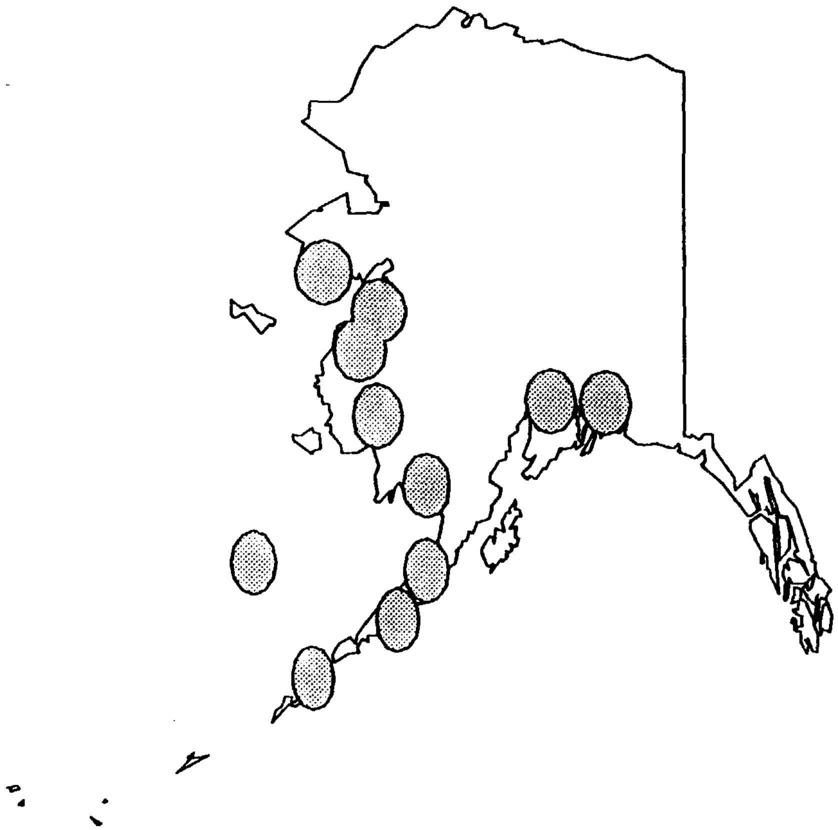


Exhibit 8-4a

19 Airport projected MLS sites in U.S. (lower 48) showing a 100 nautical mile radius interference protection region

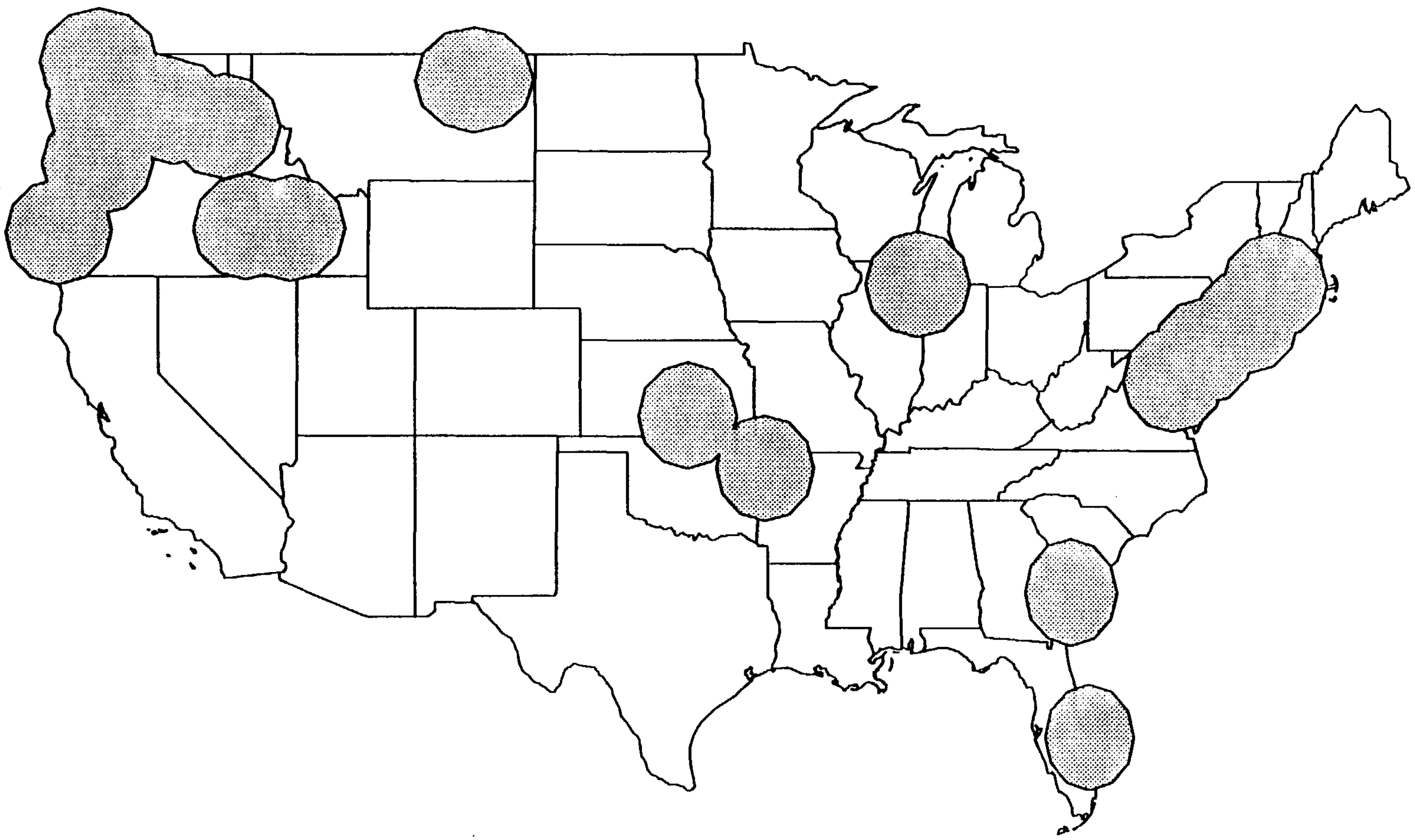


Exhibit 8-4b

11 Airport projected MLS sites in Alaska showing a 100 nautical mile radius interference protection region

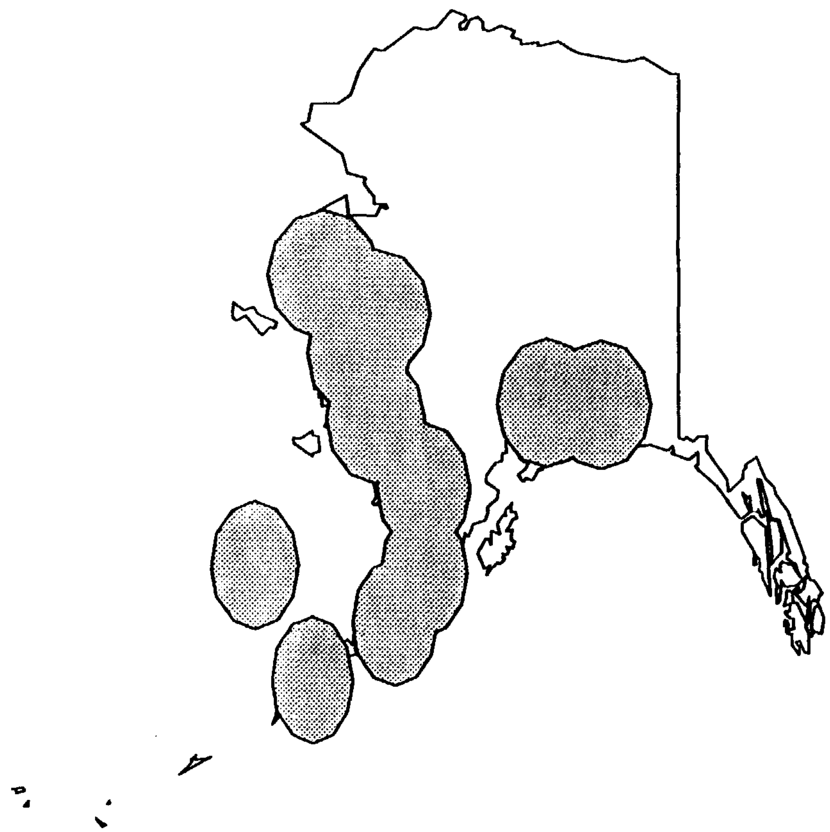


Exhibit 8-5a

19 Airport projected MLS sites in U.S. (lower 48) showing a 150 nautical mile radius interference protection region

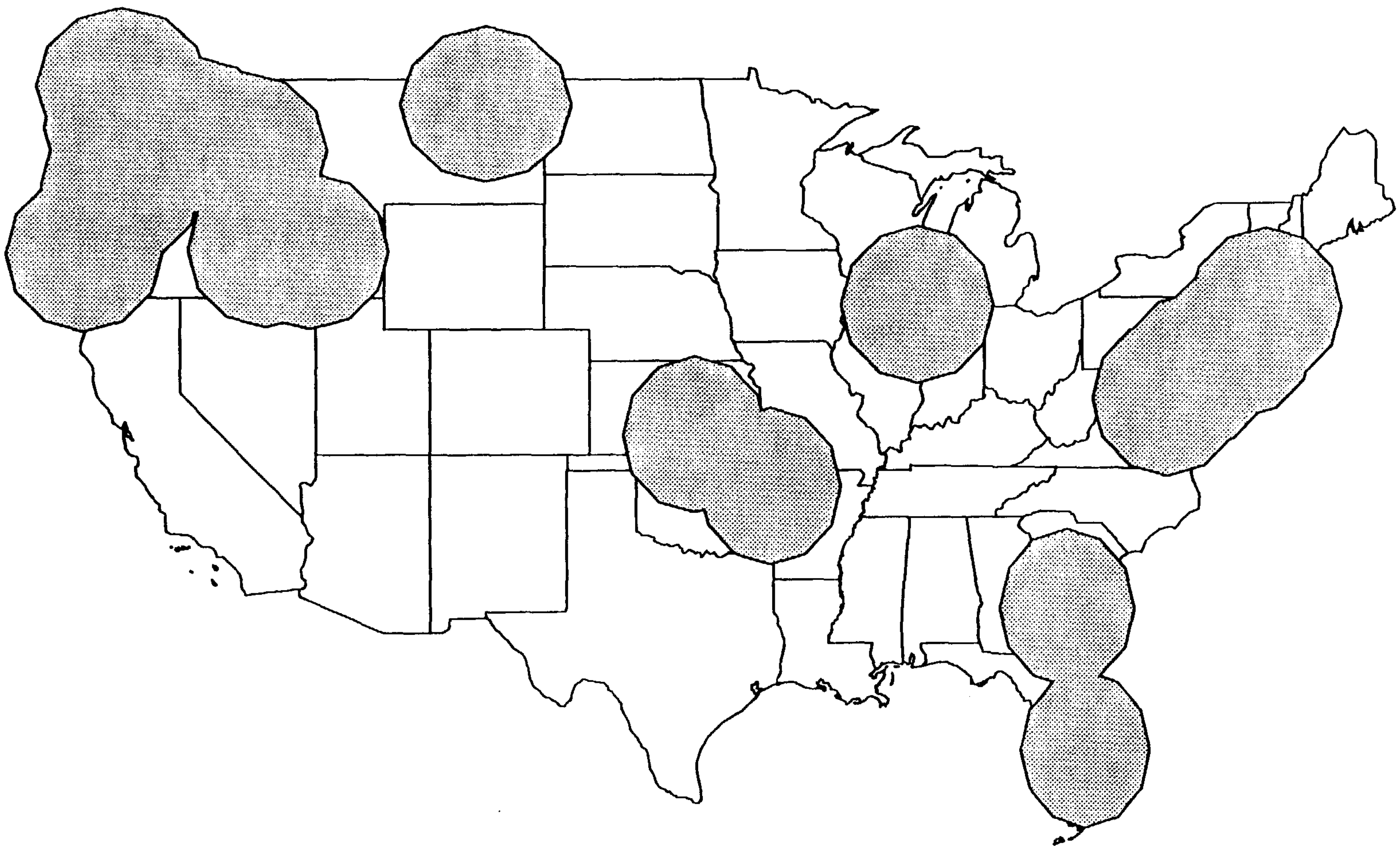


Exhibit 8-5b

11 Airport projected MLS sites in Alaska showing a 150 nautical mile radius interference protection region